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# **EXHIBIT 4**

# Dan Tormey, Ph.D., P.G.

President, Technical Director

## Education

- Ph.D., Geology and Geochemistry, MIT, 1989
- B.S., Civil Engineering and Geology, Stanford University, 1983

## Registrations

- Professional Geologist

## Appointed

- U. S. National Academy of Sciences: Giant Sequoia National Monument SAB
- California Council on Science and Technology: Hydraulic Fracturing Study
- California SB-83 Panel on Underground Injection Control
- California SB-1281 CCST study peer reviewer: Oil and Gas Water Cycle Reporting
- SPE Distinguished Lecturer
- Executive in Residence – California Polytechnic University (2004)
- IUCN Geoscientist Specialist Group
- UNESCO World Heritage Site Review
- Lead Scientist, Cruz del Sur (Andean post-disaster search and rescue group)
- Fellow, Explorers Club

## Summary of Qualifications

Dr. Tormey is an expert in energy, water resources, and environmental policy. He works with the environmental aspects of all types of oil and gas development, including hydraulic fracturing and produced water management, pipelines, LNG terminals, refineries, natural gas storage, and retail facilities. He has conducted important assignments in onshore, offshore, nearshore, estuarine, riverine and glacial environments. Dr. Tormey has worked throughout the US, Australia, Indonesia, Italy, Chile, Ecuador, Colombia, Venezuela, Brazil, Senegal, South Africa, Armenia and the Republic of Georgia.



Dr. Tormey was SPE Distinguished Lecturer with the presentation "*First-Ever Comprehensive Environmental Characterization of Hydraulic Fracturing for Shale Oil and Gas Production*" (2015-2016). He has testified before California legislative sessions on issues related to the oil and gas industry. He has served as a technical expert in state and federal court on questions related to water supply and sustainable yield; contaminant assessment, fate and transport, remediation, water quality, and Endangered Species Act issues.

Dr. Tormey has worked on more than 30 oil and gas fields worldwide, permitted water treatment systems for oil and gas produced water, including a reverse osmosis treatment plant in central California. These projects have included evaluation of beneficial reuse of the water for agriculture, industrial, and restoration of habitat. He has evaluated carbon capture and storage using depleted oilfields as the storage reservoir, as well as the use of CO<sub>2</sub> for enhanced oil recovery. He has managed environmental impact reports for pipelines carrying oil, natural gas, hydrogen, refined products, and biosolids. He has managed or been technical lead on offshore oil and gas projects, including licensing of eight liquefied natural gas (LNG) import terminals, marine terminals, and platforms (operation, abandonment, and reuse). He has led studies of the environmental impacts of hydraulic fracturing, water injection, and other oil and gas practices. He has extensive experience in the preparation of environmental reviews supporting acquisition or divestiture of oil and gas producing facilities and related infrastructure.

Dr. Tormey has managed several "first in class" CEQA/NEPA projects, including the EIS for the first offshore liquefied natural gas terminal in the United States (Port Pelican, Gulf of Mexico); the Environmental Impact Report/EIS for the first such terminal offshore of California (Cabrillo Port, Ventura); the first use of the Federal Energy Regulatory Commission's backstop authority to override state denials of transmission line projects (SCEs Devers to Palo Verde 2 500 kV transmission line project in Arizona and California); the first EIR for a reverse osmosis water treatment system for produced water treatment at an oil field (Arroyo Grande Oil Field, California); the largest dam removal in the country (PacifiCorp Klamath Hydroelectric System Dam Removals).



## Representative Project Experience

### Reuse of Produced Water

Dr. Tormey has been at the forefront of developing approaches and procedures for management and beneficial reuse of produced water. He was part of the design team for a reverse osmosis treatment system for produced water treatment, one of the first such installations in the US (Arroyo Grande Oil Field, California). For this project, he also led the technical environmental studies, and obtained permits for the operation, and worked with local communities and government in order to gain Social License to Operate. He advised Chevron on a similar treatment system in Monterey County (San Ardo Oil Field), and conducted produced water management projects in Australia (Arrow Energy, Queensland and Metgasco in New South Wales). These projects have included evaluation of beneficial reuse of the water for agriculture, industrial, and restoration of habitat.

Dr. Tormey developed a successful and reproducible approach to identifying produced water reuse opportunities, and has given talks at professional society meetings and agency/university/industry workshops. He has also published *A New View of Produced Water: Resource, Not Waste* (SPE-174049-MS, SPE WRM 2015) on the topic, providing the framework to create comprehensive Produced Water Management Plans that provide operators with a large suite of options to beneficially reuse produced water.

#### *Water Reuse, Marketing, Reverse Osmosis Facility Design, Permitting, and CEQA Compliance for Treated Water Reuse (Client – Plains Exploration and Production Company)*

Project manager for addressing environmental issues associated with reuse of reverse-osmosis treated produced water from the Arroyo Grande Oilfield near Pismo Beach, California. Determined facility infrastructure needs, and evaluated the quantity and seasonality in treated water availability. Conducted a regional study of the marketability of treated water, considering agricultural use, non-edible crop use, groundwater recharge and displacement of potable water use on the oilfield. Prepared NPDES applications for both surface application and discharge to Pismo Creek. Conducted a CEQA – equivalent analysis for a supplemental report the San Luis Obispo County, the CEQA lead agency, as part of the Conditional Use Permit application. Studies included long-term water quality and temperature monitoring in Pismo Creek, a treated water reuse options study for the Regional Water Quality Control Board, geomorphological studies including channel transects, hydrologic analysis including HEC-RAS and other methods, biological surveys for aquatic and riparian species, including steelhead and tidewater goby, and agency outreach/consultation. Also consulted with a non-governmental organization concerned about steelhead recovery efforts in Pismo Creek in order to obtain unpublished information, and to achieve buy-in on study methods.

#### *Produced Water Management Plan Including Irrigation—New South Wales, Australia*

Developed strategy for produced water management at a coal seam gas field in New South Wales Australia. Characterized the quantity and quality of the produced waters, and identified beneficial reuse of the water in the area. Matched the required water quality objectives of each beneficial reuse with treatment technologies. Focus was on agricultural reuse of produced water. In this regard, evaluated the effect of elevated salinity on crop and herd health, and soil structure.

#### *Environmental Management System/Environmental Risk Register—Queensland, Australia*

Development of environmental management system for a coal seam gas producer in the Surat Basin of Queensland, Australia. Facilitated 12 workshops with each business unit, in order to develop a register of environmental hazards, the consequences of those hazards, and the likelihood of occurrence. A focus was on the program of treatment and reuse of produced water. The data was used to quantify risk, and then to use



the risk analysis to prioritize future actions to mitigate those risks. The objective is to merge the risk analysis into an environmental management system. The EMS would then connect with the Safety Management system for the fields.

#### *Caltex/Chevron Oilfield Environmental Risks, Consequences, and Contingency Analysis—Sumatra, Indonesia*

Performed a comprehensive environmental review of the Caltex Coastal Plains Pekanbaru Block in Sumatra Indonesia including a focus on the risks and potential for use and reuse of produced water. The assessment preceded divestiture of the field to Pertamina, the Indonesian state oil company, and was intended to document baseline conditions, and identify opportunities and threats to Caltex's position in Indonesia as a result of the divestiture and subsequent operations. Included 2 weeks in the field on Sumatra, and presentation to the president of ChevronTexaco Overseas Production Company. The core of the work included review of ISO 14000 certification materials and recommended improvements to risk identification, consequence analysis, mitigation measures, and most importantly use and communication of the results to field operators and local stakeholders.

#### Chemical Fate and Transport, Site Remediation

Dr. Tormey's education and technical excellence as a geologist, geochemist, and engineer with well-developed skills in framing and analyzing the fate and transport of chemicals in the environment has led to significant technical advances in the field of chemical fate and transport analysis. Dr. Tormey has been project manager or technical lead for over two hundred projects requiring contaminant assessment, fate and transport analysis, including fate and transport modeling of chemicals in groundwater and surfacewater, study of linked groundwater-surfacewater systems, sediment transport analysis, geochemical forensics, quantification of adsorption/desorption kinetics, air dispersion modeling, comparison of remediation options, remediation system design, and installation and operation of remediation systems. Dr. Tormey has served as a technical expert in fate and transport issues supporting either litigation or agency testimony involving petroleum, MTBE, solvents, metals, pesticides, and plastic components.

Dr. Tormey's work with contaminants also includes site assessment, forensic geochemistry, risk assessment, feasibility study, and site remediation. He has worked on numerous sites impacted by MTBE, and has published results of field-scale determination of fate and transport properties (*Natural Hydraulic Control of Petroleum Transport in a California Coastal Stream*, AAPG 2004. Presentation of this paper won "Honorable Mention" among talks at the National AAPG meeting). He has also evaluated MTBE remediation, and the timing of its introduction into the western United States. He has also published papers of the relationship between fate and transport analysis and human health risk assessment (*Comprehensive Site Assessment of a Former Agricultural Chemical Facility Defines Public Risk*, NWWA 1991).

Dr. Tormey has designed numerous remediation systems worldwide. He evaluated, designed, permitted, installed, and operated remediation systems for soil and groundwater utilizing air stripping, catalytic oxidation, thermal oxidation, chemical treatment, ion exchange, carbon filtration, and bioremediation technologies, and performed field pilot studies and determined transport properties of the subsurface in support of the designs. He provides the link from site geology and hydrogeology to treatment technology feasibility evaluation, selection, and implementation. In many cases lead agency testimony and leading/facilitating public meetings was required to explain the remediation objectives, system design constraints, and modeling results. Most noteworthy is his demonstration of the effectiveness of bioremediation to address oil field wastes. He



designed a 7-acre system of bioremediation cells at a large oil field in California starting in 1993. The system is still in operation.

He has led seminars on these topics to industrial and legal societies as part of continuing education programs. On the topic of remediation in oil and gas settings, Dr. Tormey has published *Evolving On-site Remediation Technologies for Petroleum Contaminants in Soil and Water* (1995), American Bar Association; and *Soil Vapor Extraction from Heterogeneous Sedimentary Deposits* (In: Hydrocarbon Contaminated Soils and Groundwater, 1993).

#### *Estero Marine Terminal Remediation — Morro Bay, California*

Dr. Tormey conducted site assessment, risk assessment, and remedial alternative analysis for the terminal. Project manager and technical lead for a comprehensive soil and groundwater investigation of a surface water-groundwater hydrologic system at a petroleum marine terminal on the Central California coast. The Feasibility Study of Remedial Alternatives and the Remedial Action Plan have been submitted to the lead agency, the Regional Water Quality Control Board - Central Coast Region, for their review and approval. In the analysis of remedial alternatives, several environmental factors were balanced in order to demonstrate that limited further action is the preferable alternative. At this site, the factors in favor of limited further action were the impacts of Native American ethnographic resources and biological resources caused by aggressive remediation, and an unquantifiably small benefit to be gained by a very expensive program of aggressive remediation. During the investigation, the installation of well points provided a fast, cost-effective means to delineate the extent of contamination and the complicated details of a linked surface water-groundwater hydrologic system. This combined with an open approach to the regulatory community resulted in a reduction of interested agencies from eight to two, significantly reducing transaction and oversight costs. Based on the study results, an efficient monitoring and extraction well array was installed. Native American (Chumash) and biological resource concerns were respected by altering some of the field operations to limit ground-disturbing activities without a significant loss in scientific information.

#### *Fate and Transport Analysis of Dredged Material in the Orinoco Basin – Venezuela*

Conducted specialized sampling to determine oxidation potential of material to be dredged in the Orinoco River Basin, and analyzed fate and transport. Predicted likely distance downstream that acidic water quality would result.

#### *Fate and Transport Analysis for Gasoline Release – Anchor Point, Alaska*

Conducted extensive fate and transport modeling in support of a risk assessment for a release of gasoline from a service station in Anchor Point, Alaska. The plume is the largest known in Alaska. Modeling included consideration of temperature effects on biodegradation rates.

#### *Contaminant Fate and Transport Analysis for Unocal Avila Beach – Avila Beach, California*

Performed detailed contaminant fate and transport analysis in a coastal zone with strong surface water-groundwater interaction. Used geochemical modeling and mixing analysis to predict changes in concentration, and hydraulic modeling to develop timeframes for releases.

#### *Beach Remediation Project for Unocal Guadalupe – Guadalupe, California*

Designed and implemented a methodology for quantifying the volume-equivalent of petroleum recovered during the Guadalupe Beach remediation. The process was overseen by numerous agencies, including the California Department of Fish and Game, Fish and Wildlife Service, San Luis Obispo County, and others.



### *Fate and Transport Analysis, Remediation, and Coordination of Historic Contamination along Elliot Bay, Seattle*

Technical lead for evaluation of past contamination at a large development site along Elliot Bay in Seattle. Analysis included evaluation of TPH, coal tar, chlorinated organics, and other compounds that had the potential to impact development, and to have releases to the bay. Studies included site characterization and fate and transport analysis. These were used to design remediation options, including a permeable reactive wall to protect the development and surface waters.

### *Bio-Assessment and NPDES Support for the City of San Buenaventura (Ventura)'s Wastewater Treatment System Outfall – Ventura, California*

Project manager and principal technical lead for a multi-species bioassessment in the estuary of the Santa Clara River. The estuary receives up to 9 million gallons per day of tertiary-treated effluent, and the objective of the study was to characterize the ecosystem, and determine whether the system was dominantly fresh or salt water. Presented the results to the Los Angeles Regional Water Quality Control Board, and in their words “proved our case.”

### *Stocker Resources, Inc. Bioremediation Design, Permitting, and Installation - Southern California*

Dr. Tormey has designed, permitted, and overseen the operation of bioremediation cells up to 4.5 acres in extent on oilfield properties. Project Manager for projects involving the siting, design, permitting, installation, and start up of above-ground bioremediation cells at oilfield properties. Cell sizes range from 1-acre to 4.5-acres in extent. The siting involved optimization of several competing site needs, including topography and grading requirements, proximity to contaminated soil, and operation needs of the oilfields. Design and permitting included preparation of bid-ready construction drawings, and obtaining permits from the Regional Water Quality Control Board-Los Angeles Region. Installation included oversight of the construction contractor as the design was implemented in the field. Start-up included specification of nutrient mix and concentration, application rates for surfactants and water, and disking rates. Provide on-call consulting services as the cells are operated by the oilfield personnel.

### *Remediation System Design — Numerous sites worldwide*

Mr. Tormey evaluated, designed, permitted, installed, and operated remediation systems for soil and groundwater utilizing air stripping, catalytic oxidation, thermal oxidation, chemical treatment, ion exchange, carbon filtration, and bioremediation technologies. Performed field pilot studies and determined transport properties of the subsurface in support of the designs. Air quality and water quality concerns were paramount. Mr. Tormey provided the link from site geology and hydrogeology to treatment technology feasibility evaluation, selection, and implementation.

### *PG&E Fresno Service Center Closure, Fresno California*

Dr. Tormey managed the data gap assessment, risk assessment, fate and transport assessment, feasibility study, and cleanup plan for the PCB- and mineral oil-impacted service center site. The site has been investigated since the 1980s, and ENTRIX was retained to bring the site to closure in an expedited timeframe to support redevelopment of the property. ENTRIX developed an innovative regulatory approach that allowed compressing several steps into a single report. ENTRIX staff also used fate and transport analysis, and intensive regulatory negotiation to support a mineral oil cleanup standard of 35,000 mg/kg in soil. The prior level had been 1,000 mg/kg in soil; as such, this approach led to considerable cost savings, while still meeting the aggressive timeframe set forth by the redevelopment project.

### *Sherwin Williams Company Remedial Investigation — Emeryville, California*



Dr. Tormey conducted a remedial investigation and risk assessment at a paint manufacturing facility that has been in active production since the 1920's. Project Manager and technical lead for the preparation of a Remedial Investigation for an arsenic contaminated paint manufacturing facility in Emeryville, California. The study includes identification of sources of contamination, delineation of the extent of arsenic and other contaminants in soil and groundwater, and evaluation of the leaching potential from soil to groundwater. Fate and transport analysis was conducted to predict plume migration and attenuation. The analysis considered tidal influence from San Francisco Bay, preferential avenues of contaminant transport, and arsenic chemistry, including speciation, to predict changes in arsenic mobility as it encountered variable geochemical environments. The RI was prepared for the San Francisco Regional Water Quality Control Board, with the participation of the Department of Toxic Substances Control and other stakeholders through a Consultative Work Group. This approach to stakeholder involvement led to reduced comments on the draft RI, and ready acceptance of the results.

#### *Golden Gate Bridge Lead Remediation Project – San Francisco, California*

Conducted geochemical and statistical analysis to determine risk of chips of lead-based paint that had accumulated beneath the Golden Gate Bridge. Provided senior technical review for remedial option analysis and implementation.

### Oil and Gas Field Assessment

Dr. Tormey has been project manager for all aspects of oil and gas development and transport. He has worked on more than 20 oil and gas fields worldwide, permitted water treatment systems for oil and gas produced water, including a reverse osmosis treatment plant in central California. These projects have included evaluation of beneficial reuse of the water for agriculture, industrial, and restoration of habitat. He has evaluated carbon capture and storage using depleted oilfields as the storage reservoir, as well as the use of CO<sub>2</sub> for enhanced oil recovery. He has managed environmental impact reports for pipelines carrying oil, natural gas, hydrogen, refined products, and biosolids. He has managed or been technical lead on offshore oil and gas projects, including licensing of eight liquefied natural gas (LNG) import terminals, marine terminals, and platforms (operation, abandonment, and reuse). He has led studies of the environmental impacts of hydraulic fracturing, water injection, and other oil and gas practices. He has extensive experience in the preparation of environmental reviews supporting acquisition or divestiture of oil and gas producing facilities and related infrastructure. This work has been conducted in the United States, Armenia, Republic of Georgia, Ecuador, Venezuela, and Brazil.

Dr. Tormey has been project manager or task manager of numerous projects in the mining industry, including hydrogeochemistry, surfacewater-groundwater interaction, sediment transport analysis, tracer analysis interpretation, and quantification of the fate of abandoned mines. He has evaluated reclamation plans for coal mines and copper-lead-zinc mines. He has addressed the effects of mine water management on the environment, and developed plans to discharge such waters. Dr. Tormey has also analyzed the fate of abandoned mines, in particular quantifying their geochemical consequences in the environment, and drawing the link between the chemistry and human and ecological health. He was conducted this work in the United States including Alaska, Venezuela, and in Chile.

#### *Oilfield Acquisition Due Diligence – Cook Inlet, Alaska*

Conducted comprehensive environmental review in support of Hilcorp's acquisition of Chevron's Cook Inlet production facilities. The review included 6 onshore facilities and 10 offshore platforms. The review included air, water, waste, contamination, and costs. The review also included consideration of permitting constraints for future expansion, with an emphasis on air permits.



### *Evaluation of Extent of Salt-Affected Soils and Remediation—Louisiana*

Evaluated the extent of salt-affected soils related to surface disposal of produced water brines in southern Louisiana. Also considered background condition of channel realignments, tidal ranges, and storm surge levels. Considered the range of remedial options, including no further action, to address areas of elevated salinity.

### *Oilfield Acquisition Due Diligence - Montebello, California*

Conducted comprehensive environmental review of the Chevron's Montebello Oilfield in Montebello California on behalf of Stocker Resources. The review included air, water, waste, contamination, and abandonment issues and costs. The review also included consideration of permitting constraints for future expansion. Conducted Phase 2 sampling program after acquisition to validate predictions during due diligence. Designed and installed 1 acre of bioremediation cells for an anticipated 20-year cleanup of historic sites, to be implemented concurrently with continued operation of the field.

### *Oilfield Acquisition Due Diligence - Inglewood, California*

Conducted comprehensive environmental review of the Chevron's Inglewood Oilfield in Inglewood California on behalf of Stocker Resources. The review included air, water, waste, contamination, and abandonment issues and costs. Designed and installed 7 acres of bioremediation cells for an anticipated 20-year cleanup of historic sites, to be implemented concurrently with continued operation of the field.

### *Oilfield Acquisition Due Diligence - Offshore Santa Barbara and Ventura Counties, California*

Conducted comprehensive environmental review of the Chevron's Pt. Arguello Platforms, Platforms Grace and Gail, and associated offshore and onshore infrastructure in Santa Barbara, California on behalf of Plains Resources. The review included air, water, waste, contamination, and abandonment issues and costs. The review also included consideration of permitting constraints for future expansion, strategies for maintaining positive relations in an oil-unfriendly area, and consideration of rigs-to-reefs abandonment approaches.

### *Oilfield Acquisition Due Diligence - Pismo Beach, California*

Conducted comprehensive environmental review of the Aera's Arroyo Grande Oilfield in Pismo Beach, California on behalf of Stocker Resources. The review included air, water, waste, contamination, and abandonment issues and costs. The review also included consideration of permitting constraints for future expansion. Conducted Phase 2 sampling program after acquisition to validate predictions during due diligence. Conducted study to document background TPH concentrations in this area of natural oil seeps. Obtained NPDES permit for surface discharge of produced water.

### *Oilfield Acquisition Due Diligence – Bakersfield, California*

Conducted comprehensive environmental review of the Aera's Mt. Poso Oilfield in Bakersfield, California on behalf of Stocker Resources. The review included air, water, waste, contamination, and abandonment issues and costs. The review also included consideration of permitting constraints for future expansion. Conducted Phase 2 sampling program after acquisition to validate predictions during due diligence.

### *Oilfield Acquisition Due Diligence – Ventura, California*

Conducted comprehensive environmental review of the Texaco's Ventura Avenue Oilfield in Ventura, California on behalf of Stocker Resources. The review included air, water, waste, contamination, and abandonment issues and costs. The review also included consideration of permitting constraints for future expansion, and potential litigation related to spills to School Canyon.

### *Oilfield Acquisition Due Diligence – Bakersfield, California*



Conducted comprehensive environmental review of the Aera's Mt. Poso Oilfield in Bakersfield, California on behalf of Stocker Resources. The review included air, water, waste, contamination, and abandonment issues and costs. The review also included consideration of permitting constraints for future expansion. Conducted Phase 2 sampling program after acquisition to validate predictions during due diligence.

#### *Oilfield Acquisition Due Diligence – Ventura, California*

Conducted comprehensive environmental review of the Texaco's Ventura Avenue Oilfield in Ventura, California on behalf of Stocker Resources. The review included air, water, waste, contamination, and abandonment issues and costs. The review also included consideration of permitting constraints for future expansion, and potential litigation related to spills to School Canyon.

#### *Oilfield Acquisition Due Diligence – Huntington Beach, California*

Conducted comprehensive environmental review of the Aera's production in and near the Bolsa Chica Wetlands near Huntington Beach, California. The review included air, water, waste, contamination, and abandonment issues and costs. The review also included consideration of permitting constraints for future expansion based on the extensive restoration planned for the wetlands.

#### *Oilfield Acquisition Due Diligence – Illinois*

Conducted environmental review of contamination and abandonment issues at an oilfield in Illinois. Area of focus included the state's TACO standards and their applicability to the field.

#### *Burn Dump Evaluation, Kern County, California*

Project manager for a review of an extensive burn dump area held by Chevron Pipe Line Company. Conducted investigation to determine the nature and extent of burned material, and developed remediation options.

#### *Jet Fuel Products Pipeline Acquisition Due Diligence – California, Oregon, Arizona, Nevada, New Mexico, Texas*

Conducted comprehensive environmental review of the Santa Fe Pacific Pipeline Partners product system on behalf of Kinder Morgan. The system carries jet fuel, gasoline, and diesel. The review included air, water, waste, contamination, and abandonment issues and costs. The review also included consideration of the connection of the management system to the field, and evolving regulatory approaches.

#### *Oil Pipeline Acquisition Due Diligence – California, Arizona, New Mexico, Texas*

Conducted comprehensive environmental review of the All American Pipeline oil pipeline Plains Resources, later Plains All American. The review included air, water, waste, contamination, and abandonment issues and costs. The review also included consideration of permitting constraints for future expansion, and consideration of corrosion issues.

#### *Oil Pipeline Acquisition Due Diligence – California*

Conducted comprehensive environmental review of the Pacific Pipeline oil pipeline running from Bakersfield to Los Angeles, California on behalf of Plains All American. The review included air, water, waste, contamination, and abandonment issues and costs. The review also included consideration of permitting constraints for future expansion, and consideration of corrosion issues.

#### *Comprehensive study of natural seeps, San Luis Obispo, California*

Dr. Tormey led field and literature study of naturally-occurring oil and gas seeps in the Price Canyon area of San Luis Obispo Canyon. The evaluation included records of the earliest Spanish exploration of the area, to the use of hydrogeology and forensic geochemistry to trace the origin, fate, and transport of the material.



### *Seep and gas capture evaluation, Santa Barbara and Ventura Counties, California*

Field evaluation of naturally-occurring oil and natural gas seeps onshore in Ventura County, and offshore/onshore Santa Barbara County, California. Evaluations focused on occurrence and persistence of seeps, and their relationship to ongoing oil and gas field development in the areas.

### *Comprehensive analysis of impacts of high-volume hydraulic fracturing at an oil and gas field in California*

In the first-ever environmental study of its type, Dr. Tormey is technical lead for evaluation of the effects of high volume hydraulic fracturing on the local environment at an oil and gas field in California. Analysis uses numerous lines of evidence, including a monitor well array with chemical and methane sampling (including isotopes of methane), microseismic measurements, vibration and noise analysis, and characterization of the environmental attributes of the chemical packages used.

### *Characterization of Produced Water from Hydraulic Fracturing*

Designed and implemented a study to characterize the chemical characteristics of produced water from a gas field with high-volume hydraulic fracturing. Evaluated all aspects of field operations to develop a statistically-robust sample plan. Data used to evaluate labeling requirements, reuse options, and disposal options.

### *Methane Fingerprinting Study*

In response to detections of high levels of methane in soil gas, evaluated the possible sources of occurrence, including active oil wells, older abandoned oil wells, gas pipelines, sewer pipelines, and shallow level organic material decay. Used geological mapping, soil gas profiles to characterize gas geochemistry including isotopic analysis, and identification of the locations of known or suspected sources.

## Environmental Impact Studies

Dr. Tormey has been project manager or technical lead for many controversial Environmental Impact Assessments, and is noted for the creativity of his approaches. He has managed or been technical lead on offshore oil and gas projects, including licensing of eight liquefied natural gas (LNG) import terminals, marine terminals, and platforms (operation, abandonment, and reuse). These projects have included the first application for an offshore LNG terminal in the US (Port Pelican, Chevron), the first such project offshore Southern California (Cabrillo Port, BHP-B), the first such project offshore of Senegal, and the greenest of the projects (Tidelands Esperanza Port offshore of Long Beach, California). The experience spans the range of installations (gravity based to low profile floating), and the range of environmental issues addressed over the time period. The projects showcased many of Dr. Tormey's technical skills in facility engineering, geotechnical analysis, water resources, and environmental policy.

The work also provided Dr. Tormey with the platform to develop approaches towards gaining Social License to Operate. This innovative recognition saw that *government* license to operate can be relatively easy to predict, but the willingness of those affected by a project to accept it (*social* license to operate) can be very complicated. Dr. Tormey has given classes and talks on the topic to various audiences, and was a principal presenter at an SPE-hosted workshop in Vancouver British Columbia called "LNG: From Wellheads to Global Markets", with his presentation of *Environmental Lessons Learned from the 2001-2007 Boom in LNG Import Terminals* (2014).

His commitment to fact-based, objective environmental analysis means that he is equally trusted by government agencies and industry: he has managed projects for regulatory agencies (US Bureau of Land Management, US Bureau of Reclamation, US Forest Service, Federal Energy Regulatory Commission, US Army Corps of Engineers, California Public Utilities Commission, California State Lands Commission, and San Diego



Regional Water Quality Control Board, and others) and for Project applicants (Chevron, Conoco Phillips, Shell, British Gas, Plains All American, TORP, Southern California Edison, Pacific Gas and Electric Company, Southern California Gas Company, and others). International work in this topic led to publication of *Mitigating the Consequences of Extreme Events on Strategic Facilities: Evaluation of Volcanic and Seismic Risk Affecting the Caspian Oil and Gas Pipelines in the Republic of Georgia*, in the Journal of Environmental Management (2011).

Dr. Tormey has been at the forefront of evaluating the impacts of development projects on global climate, including greenhouse gas emission calculations and variability in trapping efficiency of different compounds. He has also evaluated several types of mitigation strategies, including technology replacement and carbon sequestration. Dr. Tormey is also actively working in the field of adaptation to climate change. This work includes consulting with water and energy companies regarding the likelihood of changes to water-dependent operations as a result of climate change. Dr. Tormey has also submitted a paper to the peer-reviewed journal *Global and Planetary Change* that evaluated the geohazards posed by melting glaciers at the summit of volcanoes in the tropics and temperate zones. His work with carbon sequestration includes strategic work after the initial Kyoto Protocols were developed, consulting with energy companies regarding the likelihood of obtaining carbon credits for different types of biosequestration including reforestation efforts and improved forest management techniques. He has continued work in biosequestration, including work in Alaska regarding the sequestration potential of enhanced growth of arctic tundra. He has also worked extensively in the agricultural industry, and evaluated the air quality impacts of these operations, including mitigation strategies to capture methane emissions from treatment lagoons. He has worked on a team designing an “ecovillage” in South Africa, developed to be self-sustaining in food, water, and energy. Dr. Tormey is also evaluation geological sequestration opportunities in the United States.

#### *BHP-B Offshore LNG Terminal Strategy and Permitting — Ventura and Long Beach, California*

Technical lead for preparation of a Proponent’s Environmental Assessment and applications to California State Lands Commission and the United States Coast Guard for a liquefied natural gas (LNG) receiving terminal offshore of Ventura, California and offshore of Long Beach, California. The extensive environmental documentation was prepared to support agency and stakeholder interactions, and to provide the basis for the CEQA/NEPA review. Conducted extensive stakeholder support, including liaison with the California Coastal Commission and the California Coastal Conservancy.

#### *ChevronTexaco Offshore LNG Terminal Permitting — Gulf of Mexico*

Dr. Tormey prepared permit applications for the Coast Guard and other agencies in support of ChevronTexaco’s Pelican Project. This was the first project submitted to the Coast Guard under the revisions to the Deep Water Port Act. Provided senior technical support in project scoping and review of technical chapters contained in the application.

#### *CEQA Review, Newhall Land and Farming Program EIR/EIS—Santa Clarita, California*

Managed and prepared chapters on hazards/hazardous materials, water quality, hydrology, and geomorphology for Newhall Ranch Natural Resources Conservation Plan and Spineflower Preserve EIR/EIS. Project included comprehensive analysis of impact to drainages tributary to the Santa Clara River, and including the river. Hazards analysis focused on conversion of oilfield property to residential.